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Lubrication

A Technical Publication Devoted to
the Selection and Use of Lubricants

THIS ISSUE

Lubrication a Factor
in Modern Sanitary
Engineering



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Lubrication a Factor in Modern Sanitary Engineering

WHEN the petroleum industry was in its infancy, some fifty or more years ago, another vital industry was passing through a similar stage of intensive development, in keeping with the progress of civilization. It involved sanitation and the disposal of waste materials. In the beginning, it was an off-shoot from the profession of civil engineering. Today, however, it has become a profession in its own right for the sanitary engineer must be a specialist trained in the rudiments of civil engineering, the arts of chemistry, the study of biology and experienced in dealing with constructional problems of a most diverse nature.

With all the above, the question can rightly be raised, where does lubrication fit into this scheme of public welfare? To some, a sewage system is related to lubrication only to the extent to which it furnishes a handy place to pour crankcase drainings, little realizing the danger involved due to inflammable vapors. Furthermore, oil products disrupt the biological processes at the treating plant. When we draw attention to the marked tendency in the field of sanitary engineering to go to mechanization of sewage disposal systems in the interests of improving the dependability of operation and reduction of spread of contagious disease, the question can be readily answered. Mechanization of this nature calls for a wide variety of machinery, including pumps, screen cleaning equipment, aerators, sludge removal equipment, filters, electric motors and even in some

types of operation, the gasoline or gas engine. As a result, the petroleum industry is definitely allied to public works progress in maintenance of the operating efficiency of the modern sewage disposal plant by effective lubrication. Break-down of machinery through lack of lubrication, may have a serious public health reaction where dependence for purification rests entirely on mechanical equipment.

Conditions of operation in many sewage disposal plants will require careful protection of lubricants if they are to function effectively. Moisture or the possibility of actual contact with water and acids present are especially aggravating conditions which may materially affect the performance of certain types of lubricants.

Temperature must also be considered; normally from two angles, i.e., the extent to which high bearing temperatures might result due to presence of abrasive contaminants in any of the lubricating systems, which would lead to scoring, metallic friction and impaired lubrication, and the possibility of certain of the operating mechanisms having to function under comparatively low water temperatures.

It is important to remember, however, that in contrast with many types of industrial machinery, the only way in which high temperatures may develop in a disposal plant is through friction; there is normally little or no possibility of external heat being transmitted to the bearings, as might occur on machinery using steam

power. Conversely, in the case of parts subjected to continued low temperatures, impaired lubrication may be caused by reduction in the fluidity of the lubricant, which may prevent it reaching the parts to be lubricated. If an oil

or relatively buttery consistency, it will have the least tendency to become so heavy as to be incapable of delivery to the bearings.

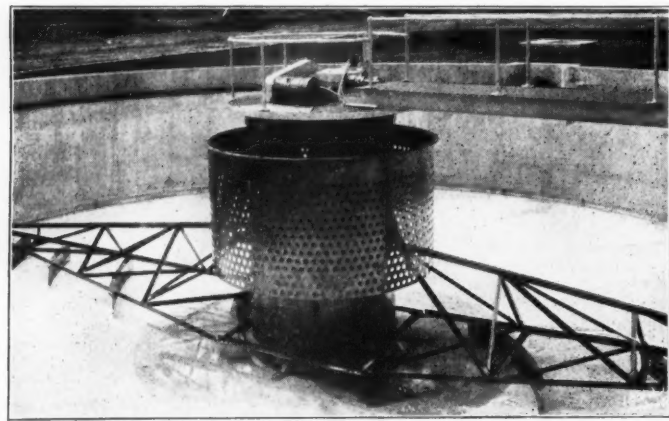
CLARIFIER AND SLUDGE COLLECTOR OPERATIONS

Sewage, during its passage through the treating plant, must be clarified, a process which involves removal of solids capable of settling or floating. This is carried out in sedimentation tanks with the aid of gravity and mechanical clarifiers. Three definite layers will be formed in these tanks; the bottom layer consisting of sludge products heavier than water, the central layer being the water or strictly fluid matter, with a top layer of substance lighter than water.

Mechanical handling of sedimentary matter has been adopted as a means of speeding up the process of clarification and prevention of gas formation by septic action, which would agitate the contents of the tanks and retard the process of separation. The clarifier serves this

purpose by continuous removal of sludge with the minimum of agitation; in addition, tank capacity is kept at a maximum.

The equipment for this purpose, according to Public Works Manual of Sewage Disposal Equipment, involves "four general types of sludge collectors: 1) in which the mechanism revolves about a central shaft; 2) in which a series of blades or flights are drawn in a straight line through the tank by endless chains; 3) a combination of 1 and 2, a revolving

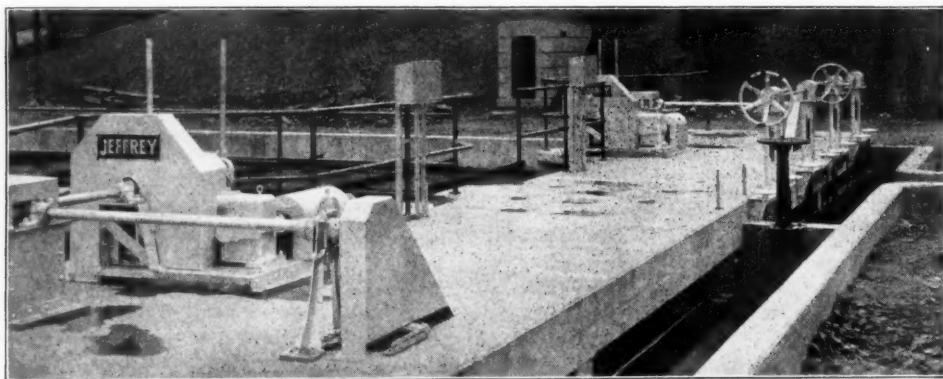


Courtesy of The Dorr Company, Inc.

Fig. 1—Drive unit of a Dorr Sifed Clarifier. This consists of a geared motor, the slow speed shaft of which drives through a chain and sprocket to a worm and gear lying in horizontal position. Below the worm gear is a spur pinion on the other end of the worm gear shaft. This pinion drives an internal ring gear which forms the turn-table top from which the Clarifier raking mechanism is suspended.

or grease of suitable refinement is used, however, this has been anticipated by the refiner purposely to assure that there will be the least possible congealment at low temperatures.

Both the pour test and relative viscosity must be considered when selecting a lubricating oil for this type of service. The former is perhaps the more positive indication, and if it shows that the oil in question flows at around zero Fahrenheit, the possibility of impaired lubrication will be remote. When considering



Courtesy of The Jeffrey Manufacturing Company

Fig. 2—Drive unit on a Jeffrey Primary Settling Tank.

grease for low temperature work, both the pour test of the oil component and the structure of the finished product are important. Obviously, the oil should have at least a zero pour test. In turn, if the grease is of "short"

arm carrying, on an endless chain, flights which push the sludge radially from the perimeter to the central well; 4) in which a traveller which spans the tank moves from one end of it to the other, a submerged scraper which is suspended

LUBRICATION

from it pushing the sludge toward hoppers. For using the first and third, the tank must be round, square or other regular geometrical figure. The second and fourth are used in either square or rectangular tanks—generally in the latter.”

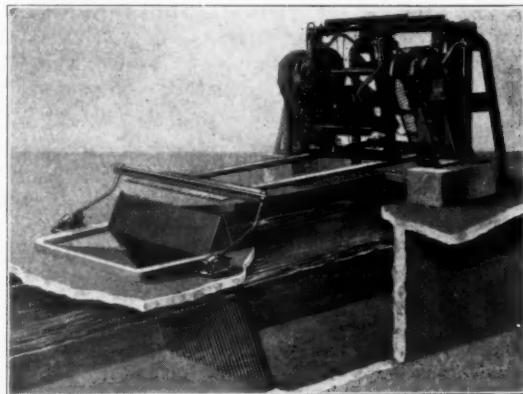
Lubrication of these various mechanisms is confined to the top-side driving parts; all submerged mechanisms receive adequate lubrication from the oily matter present in the sludge. Electric motor power is customarily used to operate the collectors, with suitable gear reduction to develop the very slow motion necessary approximating two feet per minute. In addition, some devices may require a flexible chain connection from the main drive.

Due to the exposed location of these mechanisms, they are normally very tightly housed which is an adjunct to effective lubrication, and conducive to the use of comparatively fluid lubricants which will function positively with minimum drag over a wide range of atmospheric temperatures.

SCREEN CLEANING

Chain or bar conveyor elements, as applied to screen cleaning equipment and other devices in the mechanized sewage disposal plant, will be exposed to severe moisture conditions and the possibility of considerable contact with non-lubricating foreign matter. To a large degree, the builders of such equipment have anticipated these conditions and designed their bearing housings and chain-link mechanisms in such a manner as to prevent direct entry of foreign substances. Cost of manufacture normally prohibits the use of absolutely tight sealing media, however, so it devolves upon lubrication to serve as a metal protective as well as a means of preventing abnormal friction.

the cleanings directly to a grinder. The bar screen is also designed by some manufacturers to function in conjunction with endless chain conveyors or bucket elevators to facilitate accumulation and removal of the screenings.



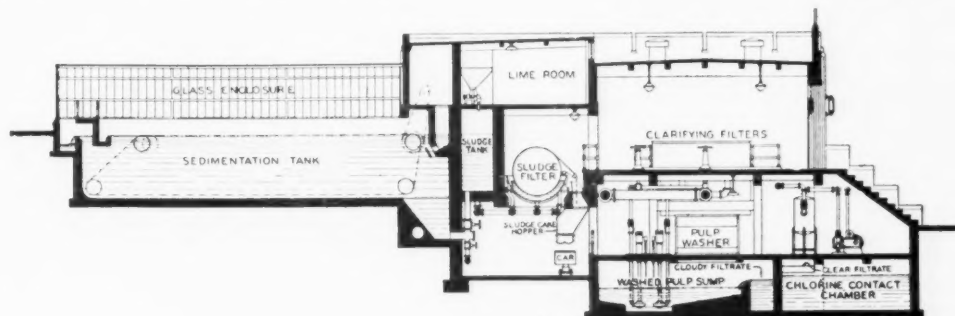
Courtesy of The Dorr Company, Inc.

Fig. 4—Phantom view of a Dorrco Bar Screen. The drive of this unit is from a motor through Texropes to a worm gear which is contained in the housing just above the motor.

Another type of equipment for removal of floating foreign matter involves a revolving or reciprocating rake which functions as a skimming device in connection with settling tanks.

Chain and Sprocket Mechanisms

Endless chain conveyors and bucket elevators require sprockets to keep the conveying elements in position. It is generally unnecessary to consider lubrication of the sprocket teeth for they are functioning continually in more or less of a water bath. Chain or bar link mechanisms, however, or the bearings which carry the buckets must often be carefully lubricated with a water-resistant grease to



Courtesy of Municipal Sanitary Service Corporation

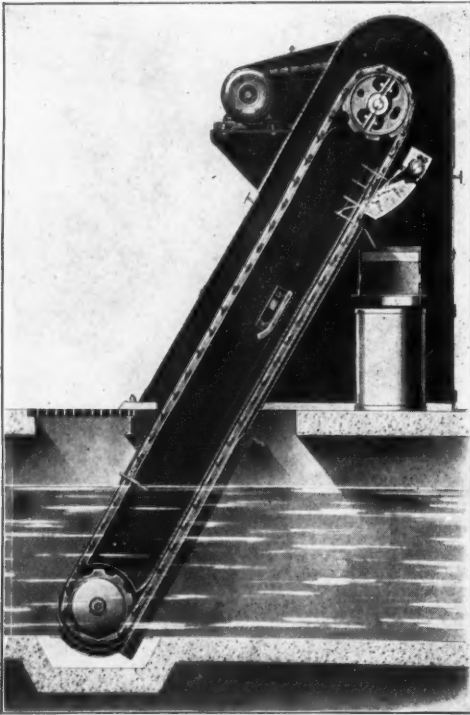
Fig. 3—Sectional view through a typical sewage treatment plant of the filtration type.

Screen cleaning by mechanical means is convenient, economical and decidedly protective of pump mechanisms. It is practicable, furthermore, to build the bar type of screen with its mechanical rake so operated as to deliver

prevent entry of abrasive materials which would promote bearing wear.

Research in regard to the manufacture of insoluble greases has progressed markedly over recent years. It has been fostered by the neces-

sity for more positive water pump lubrication on automotive engines, and for gate mechanism protection in the hydraulic turbine plant. This latest requirement, as presented by the mechanized sewage disposal system, has further justified these activities in grease research.



Courtesy of Chain Belt Company

Fig. 5—Sectional view showing action of the Rex Bar Screen and Rake Cleaner; also location of screening trough and can.

The results of this work have been especially interesting in view of the wide temperature range to which such greases are adaptable and their ability to withstand the washing action of water and effectively prevent foreign matter from working into bearing clearance spaces.

CONVEYOR MECHANISMS

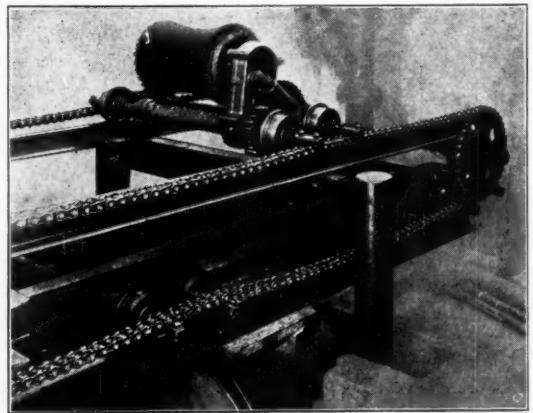
Conveyors are used where non-fluid materials such as de-hydrated sludge is to be handled in any volume in the regular course of daily plant operation. The usual rough service to which conveyor mechanisms may be subject therefore requires careful consideration of their maintenance and upkeep. Due to their rugged construction many conveyors will continue to operate irrespective of the care received, the loads applied, or the manner in which wearing parts are lubricated. Some operators assume that they can neglect or even abuse conveyors almost indefinitely, and still get the results desired. Operation of a conveyor, however, requires power, and it is amazing how power consumption will increase if operating condi-

tions are unfavorable and frictional resistance is allowed to build up. These factors have been fully realized in connection with sewage disposal work.

There will always be a certain amount of friction between the bearing surfaces, rollers, chains, sprockets, and gearing, with more or less resultant wear. If this is allowed to continue, ultimately the conveyor must be cut out of service for repairs, to the detriment of production efficiency. Fortunately, friction and excessive wear can be reduced by effective lubrication, provided constructional details are correct.

Conveyor Construction

Conveyors in general are built for endurance and hard service. The screw type, which is essentially a stamped or rolled steel spiral, secured by lugs to a pipe shaft, and the ribbon conveyor which consists of a ribbon flight similarly secured to the shaft, with an open space between the ribbon and shaft, are subject, probably, to the most severe service. The screw, or as it is sometimes termed, "the spiral conveyor," is designed for horizontal moving of dry materials in contrast with the ribbon conveyor, which is designed to handle damp, sticky materials which would otherwise build up around the shaft of a spiral conveyor. The principles of design of the ribbon conveyor have been applied to the mechanical aerator, for agitation of sewage in activated sludge treatment. Here, however, the ribbon in no



Courtesy of Link-Belt Company

Fig. 6—Showing chain and gear connections of a Tark screen. Note exposed nature of these mechanisms which may present a problem of lubrication.

way serves as a means for conveying materials, but solely as an agitator.

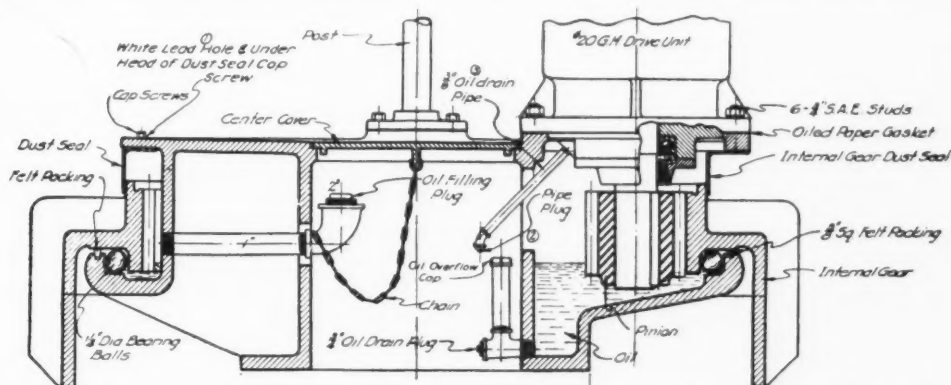
BLOWERS

The motor-driven blower designed to work in conjunction with worm reduction gearing or

LUBRICATION

a train of spur gears is an important piece of equipment in sewage disposal work where a considerable volume of air must be handled, for aeration or flocculation purposes. The blowing units deliver this air under pressure to

certain types of mechanical equipment. Where gears are enclosed in relatively tight housings, the possibility of water-entry is, of course, reduced. Furthermore, since such construction prevents loss of lubricant to a considerable



Courtesy of The Dorr Company, Inc.

Fig. 7—Assembly of the center mechanism of a Dorr Clarifier showing provisions for lubrication.

the aeration or flocculating tanks; the air functioning as an agitating media and furnishing oxygen to the bacterial life.

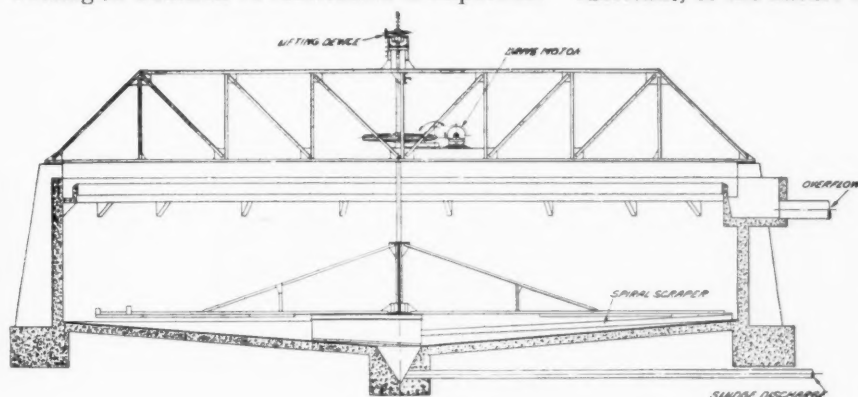
Blower operation must naturally be positive and continuous. All bearings and gear elements must therefore be adequately lubricated. The ring-oiled bearing predominates in many plants, along with a type of gear case which permits of bath lubrication. In this way, constant circulation of comparatively light viscosity oils is an adjunct to reduced power economy and maintenance of safe operating temperatures. Cooling in addition to lubrication is important

extent, it is practicable to plan for splash or pressure lubrication and use an oil which will reduce power consumption and facilitate cold starting. The amount of lubricant carried in the case should be in accordance with builders' recommendations and the design of the lubricating system.

According to prevailing loads the viscosity of such a lubricant should range from that of an extra heavy motor oil to a steam cylinder stock. Manufacturers of worm reduction gears, on the other hand, prefer a compounded lubricant, of the nature of a steam cylinder oil, containing in the neighborhood of five percent of animal fat.

Where gears are only partly protected, experience has proved that for the spur, bevel or herringbone type of reduction units a straight mineral lubricant will give best protection. It should contain no filler such as rosin or talc, etc., it should not harden,

separate, gum, dry, crack or disintegrate under exposure to varied temperatures, nor become so fluid as to run, drip or throw under ordinary temperature rises. A lubricant of the above characteristics will possess a natural tendency to follow the gear teeth, thus increasing economy to a marked extent by virtue of the decreased



Courtesy of Hardinge Company, Inc.

Fig. 8—Sectional view of a Hardinge Clarifier showing relative location of driving and lifting mechanisms to the spiral scraper.

in the operation of such machinery where fairly high operating temperatures may arise at times due to the constant type of service.

GEARS

Gearing plays an important part in the operation of the motor-driven pump, the blower and

frequency of application that is required. This adhering ability will of itself guarantee longer life to the gears by effectively protecting the teeth against wear.

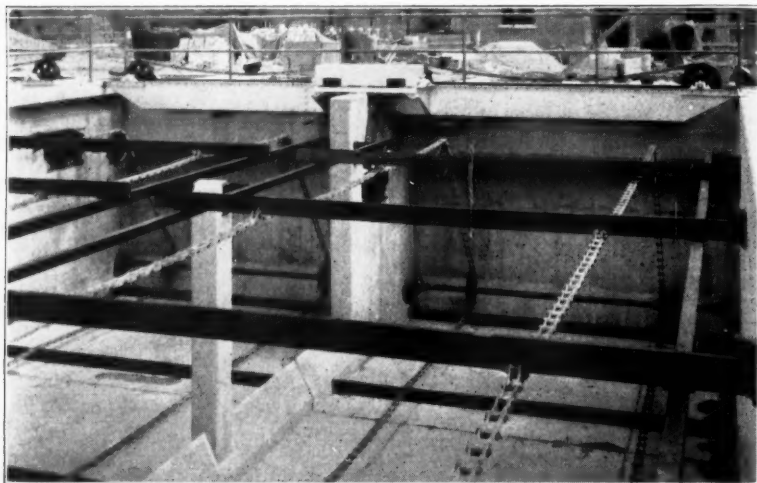


Fig. 9—Constructional details of a Jeffrey Settling Tank. All under-water bearings are especially designed for protective lubrication.

Courtesy of The Jeffrey Manufacturing Company

The Value of Tight Housings

The necessity for keeping gear teeth enclosed in comparatively oil-tight and dust-tight housings is important in the interests of effective lubrication and prevention of wear. The most essential characteristics of a good gear lubricant are that it shall have film tenacity and adequate body or viscosity to resist the throwing-off effects of centrifugal force. These very characteristics, however, also render such a lubricant subject to rapid contamination by dust or dirt, if exposed to their influence.

Contamination of this nature is, of course, decidedly objectionable as it materially reduces the lubricating ability of a gear lubricant, converting it into more or less of an abrasive paste, according to the hardness and the extent of the foreign matter involved. To prevent such contamination, gears should therefore be adequately protected by suitable casings wherever possible.

For reasons of economy or practicability, however, certain types of gear drives cannot always be properly enclosed. Many operators of older machinery in the face of such conditions, with a lack of appreciation of the serious potential consequences, such as wear, power losses, noise or personal hazard, will neglect to use any but the flimsiest kind of guards.

Gears which operate exposed either entirely or in part, will require lubricants of heavier body or viscosity than those which are tightly encased. Such a product might range in vis-

cosity from 1000 to 2000 seconds Saybolt at 210 degrees Fahr. This, of course, means that more power must be consumed in their operation for the reason that heavy lubricants im-

pose an appreciable "drag" or braking action as the teeth pass in and out of mesh. Furthermore, the heavier the lubricant the greater will be the tendency for it to pick up and absorb dust, dirt or other abrasive solid matter.

Top guards will prevent throwing of lubricant and reduce hazard to operators. On the other hand, they are of relatively little value in keeping off foreign matter.

Owing to the extent to which machinery and mechanisms may vary, it can be appreciated that gear lubrication can

very easily involve all manner of difficulties. Necessarily the lubricating engineer must deal with equipment as it stands, hence he must develop the best practices possible to meet and serve the conditions existing. To a certain extent, recommendations are possible for alteration in bearing design, gear and bearing protection against dust, preservation and reclamation of applied lubricants, etc., but to be effective this must actually be carried out by the mechanical organization of the plant, and it requires close attention and experimentation. Observation of the above will be of inestimable aid to all concerned, and if the lubricant is selected to meet conditions, and applied as advised, gear lubricating troubles will seldom be serious.

Where gears are not contained in an oil or dust-tight housing, weekly application of lubricant is usually customary, although where the gears are entirely unguarded and dust is especially excessive, this period should be decreased somewhat. It must be remembered that a lighter grade of lubricant will last longer and yield better results under such conditions. The heavier grade that would be used under clean operation cannot be expected to maintain an efficient lubricating film under dirty conditions, due to its tendency to accumulate dust. In some cases, it may even be advisable to resort to a very considerably lighter lubricant, but still one of straight mineral nature, having a viscosity of about 200 seconds Saybolt at 210 degrees Fahr., such as an automotive gear lubricant.

Oil Level Important

It is essential to remember where gears are bath lubricated that the level of the oil must be carefully watched. This will be especially true where heavier lubricants are used, and where there may be a comparatively wide range of operating temperatures, for the development of "drag" or excessive internal friction may become a decided factor in the matter of power consumption.

As a rule, where gears are bath lubricated, it will be well to carry the oil level at such a height as to insure suitable dipping of the teeth of the lower element. Submergence of too much of the gear or pinion is not advisable and, as a general rule, unless comparatively fluid oils are used, it will not be necessary. The teeth will carry an adequate amount of oil up to those of the companion gear.

With heavier gear lubricants, it will be possible to run with a somewhat lower level than where more fluid products are used. It is for this reason that reduction gear units are usually equipped with an external gauge glass to enable the operator to observe at all times just what level he is carrying.

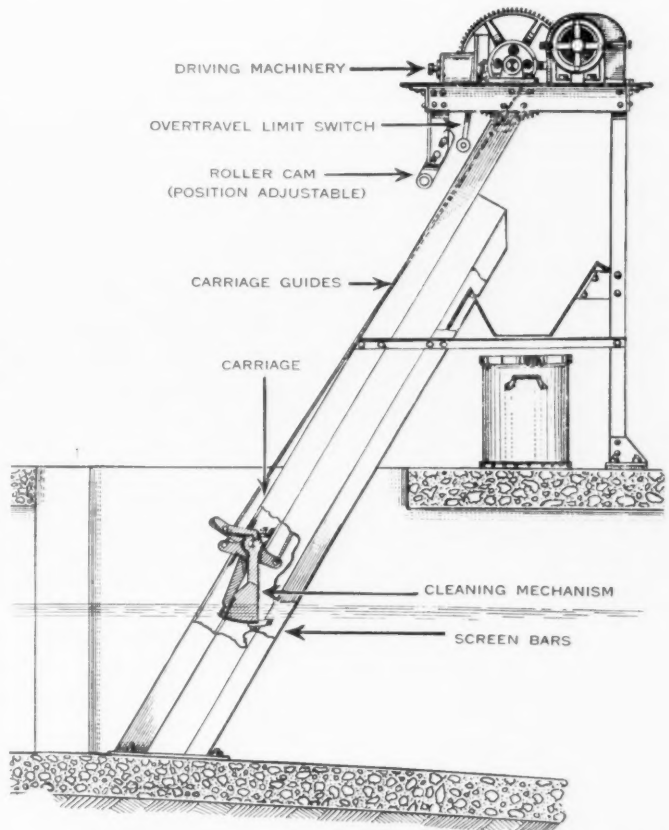
PUMPING SYSTEMS

Pump operations in sewage disposal work are largely restricted to low head, it being rarely necessary to lift the materials above twenty to thirty feet. For this service, the reciprocating plunger pump or centrifugal pump is widely preferred.

In the handling of waste materials by pumping an important factor in initial selection of the type of pump is the amount of solid matter involved and the extent to which it might clog the pumping elements. In pumps of the reciprocating type, it is obvious that the presence of sticks, rags or other such substances might sometimes interfere with free operation of the valves, even to the extent of actually causing them to become inoperative. In this respect, the means of screening and the efficiency of the screens must of course be considered, for there will be a direct relation to the efficiency and dependability of the pumps.

Another factor which will affect pump efficiency is the type of lubrication employed. Pumps are too often slighted in this respect due to their rugged and durable nature. Furthermore, they are deceptive in regard to their

power-consuming characteristics, which latter may be vitally influenced by the manner in which they are lubricated. Consequently, many will feel that as long as their pumps keep



Courtesy of Link-Belt Company

Fig. 10—Line view of the Link-Belt mechanically cleaned bar screen, showing relative location of driving machinery to other parts.

turning over, they are doing the best that can be expected under the conditions of operation. Some operators may even contend that lubrication is a luxury under these conditions.

Normally, the replacement of worn parts, or the excess of power which will be required as long as they are continued in operation, will be more costly than lubrication, even though it may be a somewhat objectionable task to the operator.

In a discussion of pump lubrication, not only must we bear in mind the types involved, but, likewise, the motive power. Broadly speaking, we will have bearings, gears and chain drives to consider, as embodied in the reciprocating plunger or piston pump and the centrifugal type.

In regard to the motive power, we would in turn have gas or gasoline engine power, and electric motors to consider, in various combinations with the above types of pumps ac-

cording to plant conditions and economies required.

Types of Pumps

In general, pumps can be grouped into two broad classifications according to the type of

should be maintained in accordance with the established recommendations of the engine manufacturer and refiner of the lubricating oil used. The latter can be especially helpful in advising as to the right grade of oil to meet specific fuel and operating conditions.

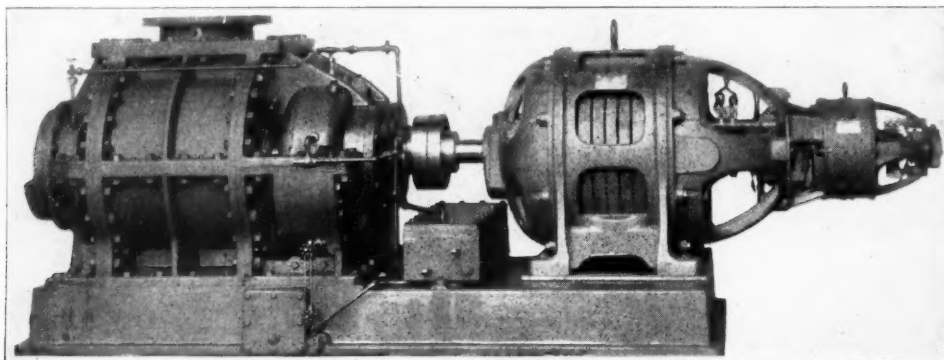


Fig. 11—Showing a typical Roots-Connorsville direct drive motor and blower installation designed for pressure lubrication.

Courtesy of Roots-Connorsville Blower Corporation

motion involved, i.e., (1) as to whether they bring about motion in a fluid by means of the reciprocating action of a piston or plunger; or (2) by the rotary motion of some form of rotor or impeller.

Reciprocating piston and plunger pumps are extremely flexible in regard to speed, pumping capacity and head. They furthermore show a relatively uniform efficiency curve under wide variations in the above conditions. They are, therefore, adapted for heavy duty, or service, under adverse conditions. On the other hand, with the exception of the triplex pump or others of more than two cylinders, there is very apt to be a certain amount of pulsation developed.

The operation of reciprocating pumps involves sliding friction between the essential operating parts. Broadly speaking, these will include pistons or plungers, valves, piston rods, valve stems, and the various external mechanisms that are required according to the type of drive installed. Reciprocating pumps can be either engine or motor driven through speed reduction mechanisms in the form of gears, chain belts or flexible "V" belts. With the electric driven pump, we will also have to deal with rotary motion as involved in the bearings of motors, gear and sprocket shafts, eccentrics, connecting rods, etc., and also the combined rolling and sliding motion that will exist between gear teeth.

Internal combustion engine lubrication

External bearing lubrication can be taken care of either by means of oil or grease according to the lubricating devices installed. In general, plain babbitted bearings will predominate. Where oil is required, a medium viscosity (200 to 300 seconds Saybolt at 100 degrees Fahr.) straight mineral product will generally be satisfactory. For grease lubrication, a medium consistency cup grease will normally be satisfactory, unless low temperatures may prevail, when a specially prepared grease of adequate plasticity should be used.

In a study of gear lubrication the ideal is to

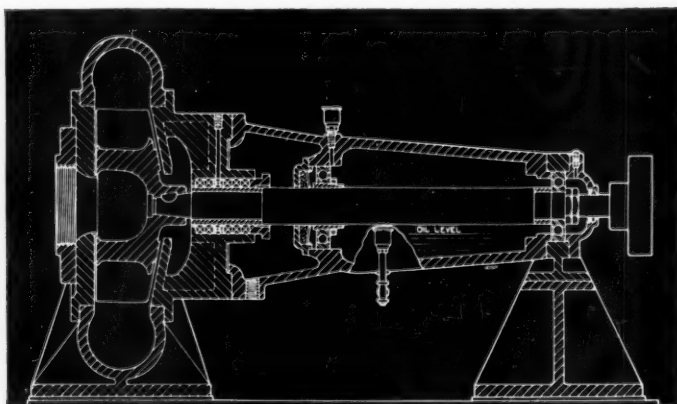


Fig. 12—Section of the Chicago Horizontal Self-Contained Non-Clog Pump. Note provisions for positive lubrication.

Courtesy of Chicago Pump Company

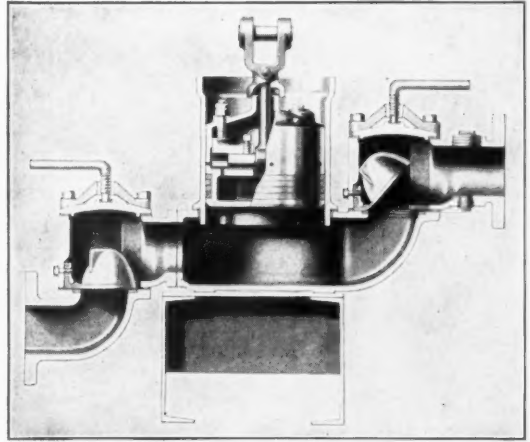
seek for noiseless operation which can be attained by the use of the right amount of the proper kind of lubricant. The essential characteristics of this latter will, in general, be its

LUBRICATION

viscosity and ability to adhere tenaciously to the teeth. The viscosity or body of such a lubricant would naturally have to be based on operating conditions such as speed, size of teeth, temperature and the amount of contaminating foreign matter involved. Needless to say, a high degree of adhesion is always an essential where exposed gearing is involved. Under such conditions, a straight mineral lubricant of from 1000 to 2000 seconds Saybolt Universal at 210 degrees Fahr., will give the best results.

On heavy duty vertical pumps, gear shaft bearings, connecting rod and pin bearings are subjected to pressures commensurate with the duty involved or the pressures that must be pumped against. These latter, to a great extent, will be dependent on the viscosity and volume of the product being pumped. To meet such bearing pressures, both grease and oil lubrication are applicable. According to the size and importance of the pump, certain builders will prefer to install compression type grease cups; others, in turn, will provide for oil, using either sight feed oil cups, ring oilers or some more or less simple form of pressure lubrication. Grease lubrication is advantageous in

It is economical and positive, but for these very reasons may sometimes be ineffectual, especially where an excess or flood of lubricant might be required, under abnormal pressure or tem-



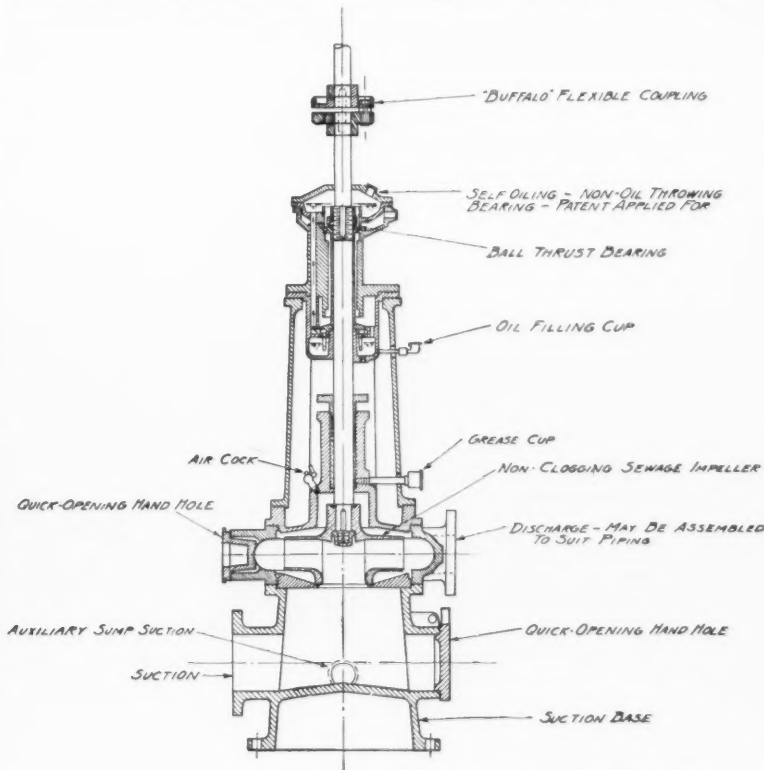
Courtesy of Chain Belt Company

Fig. 14—Details of a Rex Plunger Sludge Pump. This unit is provided for circulating oil lubrication.

perature conditions. As a result, oil lubrication will, in turn, be preferred by many operators, even though more attention may be involved. The force feed lubricator, or ring oiler, of sufficient capacity, of course, reduces this matter of attention to a marked degree. Ring oilers are especially adapted to the lighter pinion shaft bearings.

Centrifugal Pumps

The centrifugal pump is distinctive in that it involves no valves, springs, or other small parts to wear out or become inoperative. Furthermore, there are no internal parts which require lubrication. Instead it involves one or more rotors or impellers revolving in a fixed plane within a suitable air tight casing. The liquid is received at the hub or center of the impeller, pressure being acquired as it is impelled outward to the circumference, via suitable blades. Dependent on the type, fixed discharge valves are used similar to stationary



Courtesy of Buffalo Steam Pump Company

Fig. 13—Line view showing the design of a Buffalo Vertical Raw Sewage Pump with all parts plainly indicated.

that it will, as a rule, prolong the filling interval and render lubrication practically automatic.

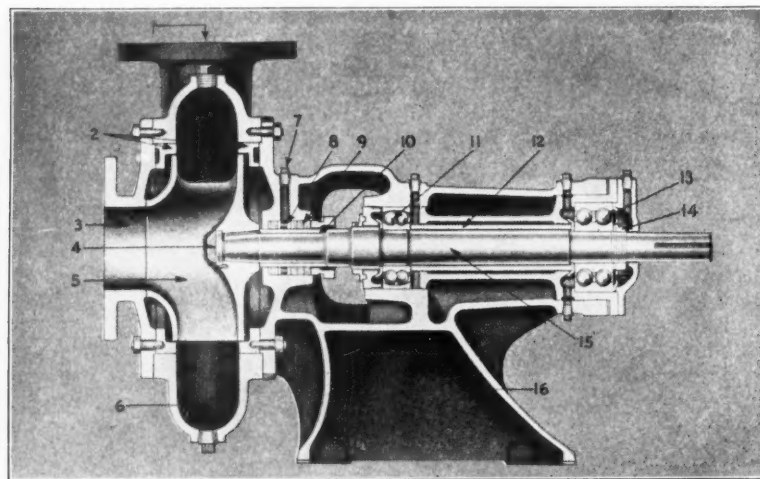
nozzles, or a suitably designed spiral casing is employed for discharge purposes. Volute pumps

are of this latter type. In order for a centrifugal pump to attain maximum efficiency it must function free from air leaks not only in the suction but also in the pump; the discharge pipe must be of such a diameter as to insure

whence it is able to flow into the bearing oil grooves and clearance space to be ultimately distributed to the entire wearing surface. As a rule, the oil after being passed through the bearing, will flow out to the end or ends of the shaft through a suitable return chamber which is part of the bearing housing, back to the oil reservoir below.

Ring oiling is today regarded by many as the simplest adaptation of the most efficient method of lubrication whereby the bearings are flooded with a considerable excess of oil over the amount that would theoretically be necessary to furnish the requisite oil film. By flooding the bearing with oil, the latter serves not only as a lubricant, but also as a cooling medium to carry away part of the frictional heat developed, thereby reducing the temperature of operation. If the oil reservoir in the base

of the bearing has been properly designed and is of sufficient capacity, this overheated oil will have ample opportunity to become sufficiently cooled after each circulation by contact with the reservoir walls, particularly



Courtesy of Fairbanks, Morse & Co.

Fig. 15—Details of the Fairbanks-Morse Horizontal Sewage Pump. Note in particular the shaft bearings of the ball bearing type, as shown by Nos. 11 and 13.

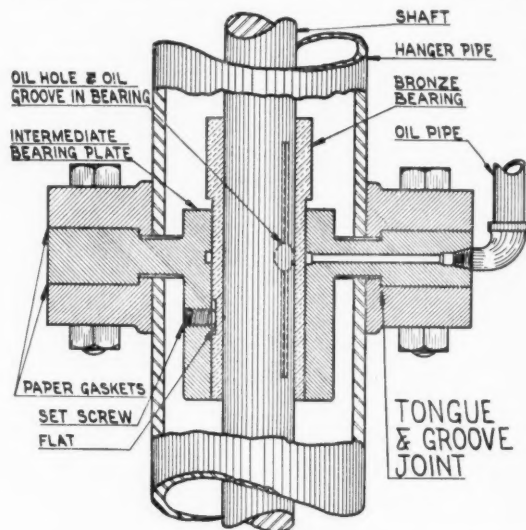
the delivery of the liquid with a minimum of friction; the operating speed must be commensurate with the pumping head; and there should be a minimum of sharp bends and elbows in any piping involved.

Lubrication

While pumps of this character will involve essentially the lubrication of bearings, these latter may be of a number of designs, and involve specific problems according to the operating conditions and the fluids being pumped. As a result, they require serious consideration and cannot be passed over as mere instances of ring oilers, ball bearings, etc., or plain babbitted bearings served by oil or grease cups.

For general all-round service on horizontal pumps, the ring oiler is preferred by many builders due to its comparative simplicity, cleanliness, the extent to which it brings about automatic lubrication, the small amount of attention which it requires, its economy, and the uniformity and regularity of oil distribution.

In construction, the ring oiler comprises a bearing housing which is built with a reservoir and a slot of sufficient width and depth to permit one or more rings suspended from the shaft to revolve therein. As a result, with the revolution of the shaft, these rings, being subjected to rotation, will carry a certain amount of oil to the top of the shaft from



Courtesy of Chicago Pump Company

Fig. 16—Details of the intermediate bearing of a Chicago Non-Clog Sewage Pump, showing means for oil lubrication.

if the radiation of the latter is not interfered with.

Lubricating systems of this nature possess natural advantages in that the flood of oil

LUBRICATION

which is constantly passing through the bearings, tends to wash out any grit, dirt, dust or metallic particles that may have gained entry, as a result, reducing wear to a minimum. On account of this washing action of the oil, how-

ever, the reservoir will gradually tend to accumulate a certain amount of sedimentary deposits. Therefore, it should be flushed out and cleaned at intervals, the old oil being replaced with new or purified oil. This is especially important when such a system is new and

core sand, etc., may be present. In such cases, several weekly changes are recommended.

Ball or roller bearings are, however, preferred on certain of such types of pumps. They are advantageous in that they supplant sliding motion with rolling motion, thereby theoretically reducing the resultant friction where properly lubricated. In the lubrication of either type, one of the chief functions of the lubricant is to prevent corrosion of the highly polished surfaces. As a result, wherever possible, the housings should be oil-tight for thereby can we reduce the viscosity of the lubricant and in consequence the internal friction that will be developed during operation. In general, one charge of oil to a roller or ball bearing equipped with a properly sealed housing should last for a period of several months.

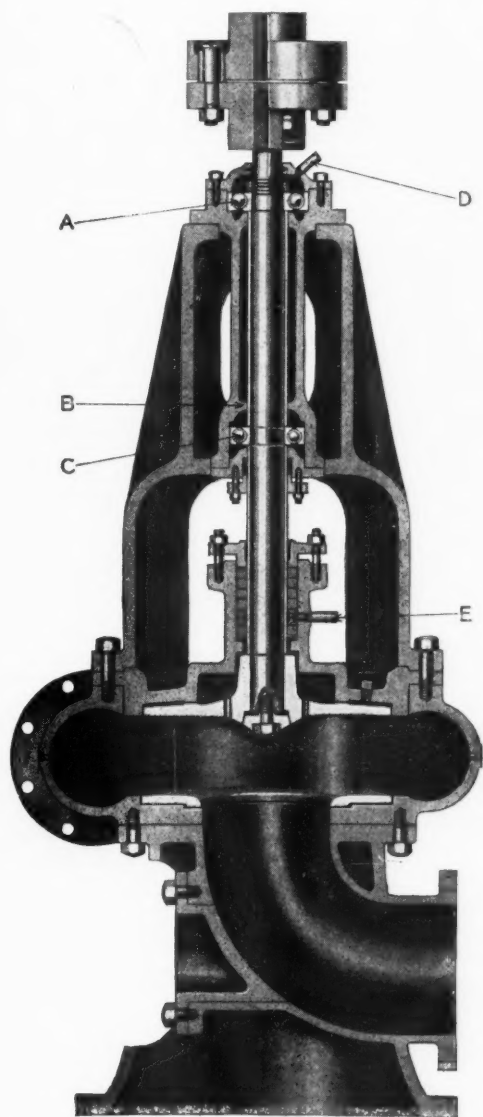
Where leakage is possible, however, a grade of semi-plastic grease should be used which will have just enough body to cause it to remain in the bearing housing. Where grease is required, it should be renewed once a month or more often, according to the extent of seal which is maintained.

All such pumps, however, will not require or be equipped with ring oilers or anti-friction bearings. In certain cases, grease cups, or sight feed oiling devices may be regarded as suitable by the builders, especially where operation is to be more or less intermittent. For such service, a medium-bodied engine oil or a plastic grade of compression cup grease will in general be found to serve the purpose.

MOTIVE POWER

While the electric motor predominates in the modern plant for operation of practically all the essential machinery, including pumps, blowers, screen cleaning, filter and clarifier mechanisms, another form of motive power equipment which has recently come into some prominence is the gas engine, designed to operate on digester gas. It serves the same purpose as the gasoline engine which has been more widely identified as a generator, pump or blower drive in plants which must function more or less as a unit, or where it is desirable to reduce the cost of purchased power. The use of gas for power generating purposes affords an added means for its disposition other than for heating purposes.

From the viewpoint of lubrication, both these types of engines present much the same conditions of operation, hence their lubrication requirements are quite similar. Normally, they are designed for pressure lubrication of all crankcase mechanisms by circulation of oil via an oil pump, usually of the geared type, located in the base of the crankcase. Cylinders in turn may be lubricated by the crankcase oil, through



Courtesy of Dayton-Dowd Company

Fig. 17—The Dayton-Dowd Vertical Type Sewage Pump. Note at (a) the heavy duty ball thrust and radial bearing which carries the weight of the pump shaft and impeller; at (b) the grease seals which are provided for all bearing housings; at (c) the heavy duty radial type grease lubricated ball bearing; at (d) the high pressure fitting for bearing lubrication, and at (e) the stuffing box which is arranged either as a clear water or grease seal.

splash, or pressure through the wrist pins, or an independent mechanical lubricator may be employed.

The combustion features of the gas engine must be somewhat different, however, in re-

Splash lubrication is adaptable to small, high speed vertical engines where the circulating oil for the bearings also furnishes lubrication for the cylinders. In this type of system, the cylinders depend primarily for their lubrication upon the oil thrown or splashed from the crankcase. During each stroke, an oil film is formed on the lower part of the piston and cylinder walls which is distributed on each successive upward stroke by the piston rings. The oil drains continually by gravity to the reservoir within the crankcase.

To enable proper and continuous distribution of oil, the sump or base of the crankcase must be kept filled to the proper level, just as in the automobile engine. This will enable the bottom ends of the connecting rods to dip and either splash or otherwise distribute oil (through suitable ducts) to all interior parts.

It is important to remember that an excess of oil may lead to abnormal carbon deposits, particularly around piston rings if the level in the case is kept too high and abnormal splash prevails. Location of the overflow should, therefore, be given careful consideration. The objections to splash, with accompanying possibility of carbon accumulations, may be overcome by using a system of oil throw. Here, provision is made for oil as it is circulated through the crank bearings to escape and be subsequently thrown to the cylinder walls in sufficient quantities to assure adequate lubrication.

In larger engines, protection of the oil in the crankcase can be insured, and carbonization around the piston rings can be prevented by locating a drain-off connection at the base or in-board end of each cylinder. Any excess oil on the cylinder walls between the bottom follower ring and the scraper ring is accumulated between these two on the down stroke and directed to the drain-off. Any water developed during the process of combustion can thereby be prevented from entering the crankcase.

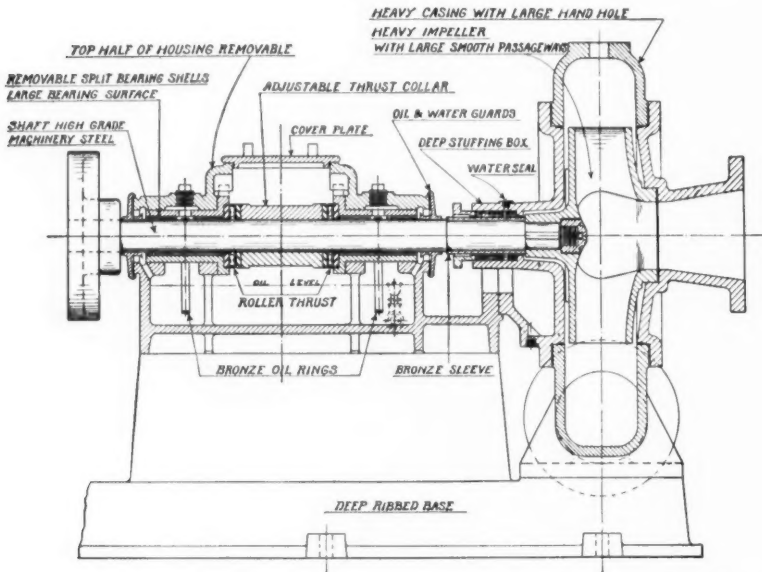


Fig. 18—Section through a Morris Standard Horizontal Type of Non-Clog Pump. Note the application of ring oiled bearings; also other details of construction.

Courtesy of Morris Machine Works.

gard to compression ratio and carburetor design, to conform to the nature of the gas. Normally, a high compression ratio is necessary, in line with the B.T.U. or heat content of the gas.

The continuous circulation of oil through bearings, affords a very practical and economical way of automatically lubricating such parts with a minimum of labor and attention. As a rule, a considerably greater volume of oil will be involved in a circulating system than in a mechanical force feed lubricator.

A typical circulating system, as designed for gas engine service, will involve a suitable oil reservoir in the base of the engine with a pump of the automotive type for transmission of oil to the bearings to be served. Pressure circulation allows for sufficient settling of the oil to insure precipitation of the greater part of any foreign matter that may have been picked up by the oil in passage through the bearings. Furthermore, this flood of lubricant serves also as a flushing and cooling medium.

